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ABSTRACT

This report begins by giving reasons for conducting research on teaching and examining the different kinds of variables that are studied in research on teaching. The types of relationships between these variables that can be studied are then discussed. Because these types of relationships constitute models for research on teaching, the paper then describes various substantive models and sketches the alternatives of inter-strategy and intra-strategy comparisons. Examples from the reports of the National Institute of Education Conference on Studies in Teaching are presented to give an idea of some of the most recent thinking about research on teaching. Finally, examples of findings from research on teaching are presented--two of which conform closely to what would normally be expected, and two of which run counter to expectations--in order to demonstrate the need for empirical research on teaching. (CD)

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Occasional Paper No. 9

MODELS FOR RESEARCH ON TEACHING

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Introductory Statement

The mission of the Stanford Center for Research and Development in Teaching is to improve teaching in American schools. Current major operations include three research and development programs--Teaching Effectiveness, The Environment for Teaching, and Teaching and Linguistic Pluralism--and two programs combining research and technical assistance, the Stanford Urban/Rural Leadership Training Institute and the Hoover/ Stanford Teacher Corps Project. The ERIC Clearinghouse on Information Resources is also a part of the Center. A program of exploratory and related studies provides for smaller studies not part of the major programs.

This lecture by N. L. Gage, Director of the Program on Teaching Effectiveness, was prepared at the invitation of the College of Education, University of Maryland.

Models for Research on Teaching*

N. L. Gage
Stanford University

It is, of course, a pleasure and an honor to be invited here to talk about models of research on teaching and to consult with you about your own ideas. Research on teaching is a subject that I consider to be close to the essence of what education is involved with. For teaching is well-nigh the point of the whole educational enterprise and the enormous establishment that supports it. After everything else has been done and provided -- the curriculums developed, the buildings erected, the money raised, the supervisors and administrators trained, the parents and citizens consulted -- we come to the point which is teaching, where all of it makes contact with the student, and knowledge, understanding, appreciation, and attitudes are influenced in what we all hope will be desirable ways.

Teaching is important not only in this way, but in terms of a kind of ethical imperative. We require by law in this country that our young people will be in frequent contact, for relatively long periods, with adults called teachers. When such a relationship is thus legally imposed on young people, it seems only fair that society should do whatever it can to make that relationship a beneficial one.

Finally, research on teaching is worth doing simply because of the intrinsic interest of the phenomena to which teaching gives rise. Even if such research had no practical value, it would be worth doing for the same reasons that astronomy and archaeology are worth pursuing. As part of our universe and of our human condition, teaching cries out to be understood and investigated.

Definition of Research on Teaching

What do we mean by models for research on teaching? By research, we mean the process of seeking relationships between variables. That simple definition applies to any discipline, whether it be in the natural or the behavioral sciences. To understand, we search for logical relationships. To predict, we search for temporal relationships. To control or improve, we search for causal relationships. Understanding, prediction, and control are the purposes of all scientific activity, including that which is concerned with teaching.

And what is teaching? We can define it as any kind of interpersonal influence aimed at improving the learning of another person. The influence is usually thought

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*A lecture presented at the University of Maryland on December 11, 1975.

of as occurring in face-to-face interaction between the teacher and the learner, but it can also take place through events that the teacher has created but which he is absent from when these events exert their influence. In that way, the authors of books and the developers of programmed instructional materials may also be considered to be teachers. For today, let us restrict our concern to teaching that goes on while the teacher is in the presence of the students.

So research on teaching becomes the search for relationships between variables where at least one of the variables is a behavior or a characteristic of teachers. The teacher variable may be an independent variable, a dependent variable, an intervening variable, or some other kind of variable, but at least one teacher variable must be involved if the research is to be considered research on teaching. It follows from this definition that research on teaching is only a part of the larger field called educational research. Not all educational research is research on teaching, but all research on teaching is a part of educational research.

Models for research on teaching are the approaches, paradigms, and basic formulations that guide a whole school of investigators. In the natural sciences, changes in basic models of research, or paradigms, have been considered to be the signals of scientific revolutions, at least in the influential definition of Thomas Kuhn's Structure of Scientific Revolutions. We have been aware of the importance of models almost as long as we have had science. For example, Pavlov created the influential conditioning model in psychology, and Skinner refined it. Ralph Tyler influenced models of curriculum development and evaluation. There are many other models in the natural and behavioral sciences. Today my task is to look at such models in the field of research on teaching.

Methods of Determining Relationships

To lay the basis for my exposition of such models, we need first to look at methods of determining relationships between variables. In the behavioral sciences, there are two major methods of determining relationships, and also some combinations and modifications of these. The two major methods are the correlational and the experimental methods.

Correlational Methods

In correlational, or survey, research, we measure variables as they occur under natural conditions, and then we use some statistical device, such as a correlation coefficient, to describe the ways in which the two variables covary. Thus, for example, we can measure the frequency with which a teacher expresses criticism or disapproval of his or her students, as one variable, and the students' scores or grades on achievement tests, as another variable. We can then find out whether there is a positive correlation between these two variables, such that the more criticism or disapproval occurs, the higher the student achievement, or a negative correlation, such that the greater the frequency of teacher criticism or disapproval, the lower the achievement.

The advantage of correlational methods is that they permit us to study the relationships between large numbers of variables with relatively little effort or expense. While you are measuring teacher criticism and disapproval, for example, you can also measure the frequency of teacher praise, the frequency of

teacher acceptance of student ideas, the frequency of teacher structuring, of teacher question-asking, and many other variables in teaching. All of these can then be correlated against student achievement, and many relationships can thus be investigated in a single study. The main disadvantage of correlational methods is that they give us little or no assurance that the relationships between the two variables are causal relationships. If we find a positive correlation between praise and student achievement, for example, we cannot safely conclude that the greater praise causes the greater achievement. In fact, it may be just the other way around, so that the greater student achievement causes a greater frequency of teacher praise.

Experimental Methods

The second major method of determining relationships is the experiment. An experiment is a study in which one of the variables is manipulated by the investigator. He applies different amounts, or qualities, of that variable to different groups of persons, who have been assigned at random to the groups receiving the different amounts or kinds of the manipulated variable. Then the experimenter measures the dependent variable, such as student achievement, and determines whether there are different average amounts of achievement associated with each of the different levels of the manipulated variable. For example, we may manipulate teacher praise by asking or training teachers to provide more or less praise during their teaching. Then, after the teaching has ended, we can measure how much students have learned. If everything else has been held constant, as it well can be through the random assignment procedure that I mentioned, then differences in achievement can properly be attributed to the different amounts of teacher praise.

So the main advantage of experiments is that they do permit us to infer a causal connection between the manipulated variable and the other variables that are found to differ after the manipulation. But the disadvantage of experiments is that they are relatively costly. It is more difficult to manipulate than to merely measure variables, especially more than one variable at a time. So, as you look at research on teaching, you find relatively few experiments, and almost no experiments in which more than one variable has been systematically manipulated.

Combining the Experimental and Correlational Approaches

Is it possible to combine the correlational and experimental approaches? It is indeed. In such a combination, we not only manipulate variables, but we measure some characteristic of our students that may be related to how much they learn. Such studies have been labeled aptitude-treatment interaction studies, or ATI studies, by Cronbach, who has been most influential in advocating, analyzing, and reviewing such studies. In the typical ATI study, some relevant characteristic of students is measured. Then the students are taught by two different teaching methods. Finally, student achievement is measured. The correlation between the student characteristic and student achievement is obtained separately for the groups of students taught by the two different methods. For each of these correlations, we can obtain a regression line, which shows the way in which student achievement changed in relation to student aptitude. If these two lines, one for each of the teaching methods, are not parallel, then we have evidence of an aptitude-treatment interaction. If the two lines actually

intersect, we can infer that one of the teaching methods was better, that is, yielded higher achievement, for students with one level of the aptitude that was measured, while the other teaching method yields higher achievement for the students at the other level of the aptitude that was measured. What this means is that one teaching method may be better for some students and another teaching method may be better for other students. This common-sense idea, which appeals so immediately to our intuitions about teaching and students, has been subjected to a considerable amount of investigation during the past 15 years, and a book by Cronbach and Snow is going to appear in the next few months as a summary and review of what that research has told us.

It turns out that significant aptitude-treatment interactions, or ATIs, are not easy to find. They do not fall off the research tree merely as a result of a few vigorous shakes. But some of them have been found, and have even been found repeatedly. For example, suppose we consider the student characteristic called anxiety. Suppose we teach more anxious and less anxious students by two different methods, a student-centered, or discussion, method and a teacher-centered, or lecture, method. It turns out that the less anxious students learn more in the student-centered classes, while the more anxious students get higher scores on the achievement tests when they are taught in the teacher-centered classes. Similarly, in teaching reading, suppose we measure the pupils' reading readiness with a test of their vocabulary and concepts. Then suppose we teach reading with two different methods, the linguistic method and the whole-word method. As it turns out, the students with high reading readiness scores learn more when taught by the linguistic method, which emphasizes decoding and word analysis, while students who are lower in reading readiness learn more when taught by the whole-word method, which emphasizes meanings, sight-identification of words, and so on. There are in the literature many more examples of such ATIs, but there have also been many failures to find ATIs where reasonable people thought they might be found.

Connoisseurship and Criticism

It would not be right to end this discussion of methods of determining relationships between variables without mentioning an approach fundamentally different from any of them. Some writers, particularly my colleague, Elliot Eisner, hold that we deny ourselves much knowledge and insight if we fail to use what he has called connoisseurship and criticism. The connoisseur is someone who gets to know his subject thoroughly by much examination of it. The subject may be wine, painting, music, drama, movies, or even teaching. The connoisseur learns what to look for and to understand what is important through the exercise of his own critical faculties and his encounters with the ideas of other connoisseurs. So the wine connoisseur learns to appreciate bouquet, body, and nose in a wine. The movie connoisseur can distinguish the fine points of difference between a Hitchcock and a Bergman, or a Capra and a Huston. And the connoisseur of teaching will presumably come to appreciate the artful use of confusion, suspense, balance, and even silence on the part of the teacher. Then the critic learns how to express, with much reliance on metaphor, the qualities of the art form that he has experienced. So the critic will be able to tell you why one kind of teaching is, in his informed judgment, better than another, for certain kinds of students, for any given subject matter. So far, this kind of study of teaching has not been practiced very often in any formal sense, although the old fashioned school inspector in various countries must have come to be something of a connoisseur and critic. Eisner has been advocating

the use of this approach as a supplement to the behavioral science methods that are usually associated with the idea of research on teaching.

The Variables

Let me turn now to the variables themselves, the relationships between which are the concern of research on teaching. For a good formulation of the types of variables in research on teaching, we can turn to Dunkin and Biddle, whose book, The Study of Teaching, is built around a categorization of variables that turns out to be highly useful. This categorization has been around for at least 20 years, but Dunkin and Biddle have made more thorough use of it than anyone else. In brief, they speak of four kinds of variables--presage variables, context variables, process variables, and product variables.

Presage Variables

Presage variables are those that are considered to have some value for predicting the ways in which teachers will behave. They may take the form of the teacher's formative experiences and environments, such as the teacher's social class, age, or sex. They may take the form of the teacher's training experiences, such as the courses, training programs, and practice teaching experiences of the teacher. Finally, they may take the form of various teacher properties, such as the teachers' skills, intelligence, motivations, values, attitudes, and personality traits.

Context Variables

Next we have context variables, or the variables that describe the environment and conditions in which the teacher works. Among these would be the various background experiences of the teacher's students, such as their social class, age, and sex. Also included here would be such pupil properties as their abilities, prior knowledge, and attitudes. Context variables would also include certain school and community characteristics, such as the ethnic composition of the student body, the size of the school, whether or not bussing goes on, and so on. Finally, context variables include various classroom phenomena, such as the size of the class, the textbooks that are available, whether or not educational television is available, the ways in which seats can be arranged, whether or not the school has walls between classrooms, and so on.

Process Variables

The third class of variables consists of process variables, or the kinds of behaviors that are exhibited in the classroom by the teacher and his or her students. Here we find the interaction between teachers and students in all its many forms, both verbal and non-verbal, both academic and non-academic, aimed at the facilitation of student achievement of cognitive, social-emotional, and psychomotor objectives. Here we also find changes in student behavior occurring as a part of the process variables.

Product Variables

Finally, we come to the variables that describe the outcomes of all of the foregoing kinds of variables, namely, the product variables. These include

the student's immediate achievement of educational objectives and also long-range effects on students, or the kinds of achievement, personality, and adjustment that they manifest after they have left the influence of a given teacher.

Direction of Influence

It should be obvious that these four categories of variables--presage, context, process, and product--should be arranged in an order reading from left to right, with arrows pointing to the right to indicate what is presumably the direction of the causal influence between these kinds of variables. Thus, the presage and context variables are considered to be the determiners of the process variables, which in turn are the determiners of the product variables. That, at least, is the kind of direction of causal influence that we tend to assume in thinking about these variables. But we often find good reason to suppose that the influence can go the other way, so that some product variables have a backward effect on process variables, and some process variables can in turn have an effect on such context variables as students' attitudes or knowledge. So the relationships between these variables are not necessarily one-way influences, and it is worthwhile to think of the influence sometimes going in the other direction.

Methodological Models

Let me turn now to what might be called methodological models for research on teaching. Under this heading, we can look at the types of possible relationships that can be specified in terms of the four categories of variables. And we can also look at the two major kinds of methodology for determining relationships between variables--these being, as I have already indicated, the correlational and experimental methods. First, there can be studies of presage-process relationships. Here we would determine the degree to which, for example, the teacher's social class background or sex or attitude has an effect on the ways in which the teacher interacts with the students in the classroom. Or we can look at context-process relationships, where we would be concerned with the ways in which the social class background of the students, or their attitudes, or ethnic composition, or class size have an effect on the ways in which teachers and students interact in the classroom.

Next, it is possible to specify process-process relationships, where a teacher or student behavior of one kind is related to teacher or student behavior of another kind. Thus, if teachers ask questions that require more than mere knowledge, recall or recognition--questions that require some application, synthesis, or evaluation of ideas--do students tend to answer in ways that reflect such higher-order mental processes? Similarly, if teachers wait a few seconds longer after they ask a question, do students' answers tend to become more satisfactory, more complete, more thoughtful? We may also ask about the ways in which student behavior influences teacher behavior. Do students who achieve learning more rapidly tend to make teachers become more relaxed and acceptant? Obviously, with all the myriad dimensions of teacher and student behavior that are conceivable, such process-process relationships can take many forms.

Finally, we come to what most students of teaching would consider to be the heart of the matter, namely, process-product relationships. Do the ways in which

teachers behave in the classroom relate to how much students learn? If teachers ask more questions calling for higher mental processes, do students tend to get higher scores on achievement tests that call for reasoning? If teachers show more of what has been called indirectness in their teaching, will students learn more? If what teachers say in the classroom is found to be more logical, in the sense of conforming better to the rules of logic in defining, explaining, comparing, and so on, will students tend to learn more? Here again, many dozens of such process-product questions have been asked in the field of research on teaching.

It is also possible to ask questions that skip the process category and go directly from presage or context variables to product variables. Here, we would ask presage-product questions--for examples whether teachers who display certain attitudes on a questionnaire or inventory have students who like the teacher better, have more favorable attitudes toward school and school subjects, and get higher scores on achievement tests. Or we can ask context-product questions, such as whether students in smaller classes, that is, classes with smaller numbers of students, learn more. But notice that that kind of question does not refer to a behavior or characteristic of teachers as such, and therefore would not be included within our definition of research on teaching.

Crossing Methods and Variable Pairs

In any case, with four or five different kinds of relationships between various categories of variables in research on teaching and with the two major methods of determining relationships between variables, namely, the correlational and experimental methods, it is easy to see that there are at least eight different models of research on teaching implied. You can do correlational studies on each of the four or five kinds of relationships, or you can do experimental studies on these relationships. And all of these various kinds of models for research on teaching have been employed in at least one study or another in the sizable literature of research on teaching.

Process Occurrence Research

Apart from these eight or ten models derived from crossing types of relationships with methods of determining relationships, there is a much simpler kind of research that also has considerable interest and importance. This is the kind of research that is concerned solely with process occurrence. How often do certain kinds of teacher or student behavior occur in our classrooms? Back in 1908, a visiting Englishwoman named Sarah Burstall described the rapid-fire question-and-answer approach to teaching that we now call the recitation method, and she found it to be far more prevalent in this country than in England. Similar studies of process occurrence have been made over the years of many other kinds of classroom behavior on the part of teachers and students. Such information is important in describing the realities of classroom life and determining the degree to which they come close to some ideal conception of those processes.

Intraclassroom Differences

Finally, we ought to note a basic distinction between methods of describing classroom processes--a distinction that has been advocated and used by Brophy and Good, especially. Until they brought the research together in their book on Teacher-Pupil Relationships, most studies of classroom process had been concerned with the behavior of teachers toward the class as a whole and the response of the class as a whole, without regard to individual students or types of students. Brophy and Good showed that it was possible to discover important phenomena if one looked at teachers' behaviors toward individual students, or types of students, and the corresponding behaviors of individual students or types of students. So they have shown that teachers behave differently toward students of different

social class backgrounds, different sexes, different ethnic backgrounds, different levels of achievement, different degrees of intelligence, and so on. They have also shown the ways in which teachers' expectations concerning different individual students or types of students are related to the ways in which teachers behave toward those individuals or categories of students.

Substantive Models

Thus far, I have dealt with methods of determining relationships between variables, with the types of variables in research on teaching, and with the methodological models that can be derived from considering the types of possible relationships and the two major ways of determining relationships. Now I should like to turn to what might be called substantive models for research on teaching. These are models that deal with the content of what is investigated. In general, that content can take the form of inter-strategy or intra-strategy comparisons. By strategies, I mean the major teaching methods, or what Joyce and Weil have called models of teaching. Examples of strategies are the lecture method, the discussion method, the classroom recitation, the open classroom, programmed instruction, computer-assisted instruction, televised instruction, role-playing, mastery approaches, personalized systems of instruction, and so on. Many studies have been conducted to compare the effectiveness of one kind of strategy with that of another. Thus, Jamison, Suppes, and Wells reviewed the literature about two years ago on the relative effectiveness of many of these various strategies. In 1968, Dubin and Taveggia published a monograph in which they reviewed nearly 100 experiments in which the lecture and discussion methods had been compared as to their effectiveness in producing achievement on final examinations at the college level. They concluded that about 50 percent of the studies favored one of these methods, and the other 50 percent favored the other method, so that overall there was nothing to choose between the methods, at least by the criterion of mean score on final examinations. Similarly, there have been many comparisons of so-called conventional instruction with programmed instruction, of tutored students, of live lecturing with televised lecturing, and so on.

Size of Group

It is possible to categorize the various strategies of teaching in terms of the size of the group for which they are suitable. When the group consists of only one student at a time, the strategies can take such form as tutoring, programmed instruction, computer-assisted instruction, independent study, homework, seatwork, and various highly organized arrangements such as individually prescribed instruction, The Program for Learning in Accordance with Needs, (called PLAN) and Individually Guided Education. When the size of the group is somewhere between 2 and 20 students, the appropriate strategies include the discussion method, role-playing, and various kinds of games. When the size of the group is greater than about 40, the appropriate methods seem to be the lecture, television instruction, films, and demonstrations. And when the size of the group is somewhere between 20 and 40 students, which is the most frequently occurring size of group in American schools, the typically used method may be called the classroom recitation. But in this conventional classroom, many if not all of the other teaching strategies or methods may also be used, and I have argued elsewhere that classroom teaching ought to consist of some kind of orchestration of all the various methods, so that the recitation is interspersed with tutoring, programmed instruction, discussion, lectures, films, seatwork, and so on, in a pattern arranged on the basis of the teacher's perceptions of students' needs and the nature of what is to be learned.

Intra-Strategy Studies

Beyond such comparisons of one strategy with another, much of the research on teaching has consisted of intra-strategy studies of process-product relation-

ships. Thus, within the classroom recitation strategy, many process variables have been studied in relation to student achievement and attitudes. Some of these have been social-emotional variables, of the kinds studied by Ned Flanders and Jacob Kounin. Other studies have been concerned with cognitive variables, such as defining, explaining, describing, and analyzing, as in the studies by Smith and Meux, by Bellack and his co-workers. Hilda Taba developed a method of conducting the recitation in the social studies which proceeded from the collection of information to the formulation of a generalization. Bloom's taxonomy led to the study of the relative effectiveness of higher-order and lower-order questions in the classroom. Guilford's structure of intelligence led to concern with divergent thinking as elicited by teachers' questions in the recitation process. Similarly, many linguistic variables have been studied. Behavior modification variables, such as reinforcement contingencies, types of modeling and imitation, and so-called token economies have been used in experiments aimed at improving student behavior and discipline in the classroom and achievement of cognitive objectives.

Within the lecture strategy, experimental and correlational studies have been concerned with such variables as teacher enthusiasm, the organization of the lecture, the use of supports for the structure of the lecture, and the degree to which the teacher used vague words such as almost, perhaps, some of, and might.

The NIE Conference on Studies in Teaching

Thus, there are inter-strategy models for research on teaching and intra-strategy comparisons that can be subjected to research on teaching. But another way of slicing the domain of research on teaching can be seen in the structure of the National Institute of Education's Conference on Studies in Teaching, which was held in June, 1974. That Conference had ten panels, each of which consisted of ten persons, among whom were research workers, teachers, administrators, representatives of teachers' organizations, and teacher educators. Each of the panels prepared a report in which it set forth the approaches, programs, and projects that it considered to be worth pursuing in its particular area. The ten panels consisted of one on teacher recruitment, selection, and retention. Then there were five panels on various approaches to teacher training and performance. These five panels were concerned, respectively, with teaching as human interaction, teaching as behavior analysis, teaching as skill performance, teaching as a linguistic process in a cultural setting, and teaching as clinical information processing. Then the seventh panel was concerned with instructional personnel utilization, or the ways in which teaching staff should be organized and administered in schools and school systems. The eighth panel was concerned with personnel roles in new instructional systems, or the ways in which teachers would function in schools that had adopted modern technology, systems approaches, computerized instruction, and systems of individualized instruction. The ninth panel was concerned with research methodology, especially in terms of statistics and measurement techniques. And, finally, the tenth panel was concerned with theory development in the field of research on teaching.

Let me go back now to touch briefly on some of the approaches that were formulated by some of these ten panels. The panel on teacher recruitment, selection, and retention was concerned with analyzing and improving methods for recruiting teachers and teacher trainees, for selecting such persons, and for investigating the relationship of teacher preparation objectives and curriculum to teacher competency and effectiveness.

The panel on teaching as human interaction formulated approaches aimed at developing ways to conceptualize and analyze such interaction. It was particularly concerned with what we have called process-product relationships. That panel saw a need not for additional ways of analyzing classroom interaction but for ways of measuring achievement of objectives toward which the teaching is aimed. It saw the latter problem as more severe at higher grade levels. Beyond this, the panel saw a need for the development of evaluative teaching units that would consist of the instructional materials, with pretests and posttests, that could be used in research on teaching. Among the products to be investigated should be not merely achievement but measures of students' attitudes toward the teacher and learning activities, for observing persistence and lack of distraction, for measuring the students' level of aspiration and self-concept. Further, this panel proposed that process-product relationships be studied in the various contexts, that is, in various kinds of schools and classrooms and in working with pupils that have different characteristics.

The panel on teaching as skill performance proposed alternative approaches to the definition and identification of general and special teaching skills. Thus, it recommended a conceptual-analytic method for identifying hypotheses as to effective skills, and it also recommended the observation and analysis of current teacher practice in relation to student outcomes as a means of identifying skills. Finally, it recommended the examination and assessment of needs and other kinds of expert opinion as a means of identifying skills. And this panel also recommended that the effects of various teaching skills and competencies on student achievement and attitude be investigated.

The panel on teaching as a linguistic process in a cultural setting was concerned with determining the rules governing classroom discourse and the relationship between such discourse and contextual factors in the school setting. It also proposed that we study the acquisition by students of the rules for school discourse and determine the ways in which differences in dialect, language style, and interactional norms affect learning in the classroom. This panel also proposed that patterns of teacher-student communication be analyzed to determine the effect of the social identity of the participants on the ways in which teachers present information and the ways in which such different presentations affect the acquisition of knowledge and skill. This panel was also concerned with the communication situations that are necessary for the acquisition of second language skills while encouraging the maintenance of the native language.

Finally, let me touch upon the ideas of the panel on teaching as clinical information processing. The report of this panel was included as part of a request for proposals issued last summer by the National Institute of Education. That request called for proposals for an Institute for Research on Teaching--an institute that would conduct research on the teaching of reading in the elementary school and also serve as an intellectual forum that would improve communication within the field of research on teaching and also between that field and educational practitioners of various kinds. By appending the report of this panel to that request for proposals, the NIE inevitably indicated that it attached special value and importance to the ideas of this panel on teaching as clinical information processing. What did that panel propose? First, it offered a conceptual model for clinical information processing which put the teacher's cognitive processes at the center of attention. Then, it dealt with the antecedents of such cognitive

processes, with the consequences of such cognitive processes for teaching, and finally, with the consequences of the teaching for students' knowledge, skills, attitudes, and so on. And what did this panel mean by teacher cognitive processes? Some of the terms that they included under that heading were expectations, perceptions, causal attributions, labeling, diagnostic judgments, hypothesis generation, and hypothesis testing. In a sense, this panel was saying that we have perhaps been overly concerned with teacher behavior and too little concerned with teachers' ideas and thoughts. So the panel proposed to regard teaching as a clinical act of diagnosis, prescription, decision making and so on, all of which would precede and determine the teacher's actions, behaviors, and interactions with students. The panel went on to propose methods for research on teaching conceived as clinical information processing. These methods included systematic introspection, or thinking aloud, the analysis of decisions, anthropological studies of teaching, and the analysis and coding of complex descriptive protocols. Here, the panel mentioned the so-called lens model developed by Brunswik, Hammond, and others, and it also referred to process tracing, "which employs introspective methods to produce a detailed, sequential model in the form of a flow chart or decision tree" (page 49).

All of this is perhaps enough to indicate the breadth and depth and variety of the ideas proposed by the various panels of the NIE Conference on Studies in Teaching. The ten panel reports make up a rich storehouse of ideas that will intrigue anyone interested in the future of research on teaching. Having whetted your appetite, I hope, let me conclude by referring you to the way in which you can obtain copies of the Panel's reports. You should write to Mr. Kent Viehoever, Program on Teaching, Basic Skills Task Force, National Institute of Education, Brown Building, 19th and M Streets, Washington, D. C. 20208.

Some Findings of Research on Teaching

Now let me conclude my discussion of models for research on teaching with a few, almost random examples of some of the findings of that research. Some of these findings are better established than others, and none of them is yet as well established as any of the laws of physics. There are even those who argue that we shall never have relationships between variables in research on teaching, or the behavioral sciences in general, that will stand the test of time, of different conditions and contexts, and fail to be at the mercy of interactions with many other variables. Nonetheless, with all possible diffidence, let me offer a few of the findings that seem to me to have held up in a variety of correlational studies and, sometimes, experiments. One such variable is what might be called enthusiasm, or dynamism, or even, somewhat pejoratively, seductive-expressiveness. Whether enthusiasm has been rated or measured by observers or, on the other hand, manipulated by experimenters, it has quite uniformly turned out that more enthusiastic teachers have students who learn differently than those of less enthusiastic teachers. But what do we mean by enthusiasm? Some indications have been highly impressionistic, or what we might call high-inference variables, where a judge makes a rating on the basis of his inferences from a highly complex and subtle combination of phenomena that he would have trouble putting his finger on. Other measures of enthusiasm have been based on so-called low-inference variables, where the manifestations are objectively observable and denotable, such as the degree to which the teacher maintains eye contact, varies his tonal intonations, uses gestures, and in other ways conveys a bit of his own excitement and concern about what he is doing. Sometimes, even a lecturer who reads his paper to his students can be regarded as

manifesting enthusiasm, if he gives off cues as to his own conviction and seriousness--cues that somehow seem to infect his students with his own sense of the importance and excitement of his subject matter. In any case, in a variety of studies, more enthusiastic teachers have been found to be different from less enthusiastic teachers in bringing about student achievement of knowledge and understanding.

Another example that has stood up rather well in perhaps ten correlational studies is "acceptance of students' ideas." This is one of the variables observed in Flanders' Interaction Analysis Categories, and in eight out of nine correlational studies, it has been correlated with student achievement. We have the problem here, of course, of whether the different student achievement is caused by, or rather is the cause of, the teachers' greater acceptance of their students' ideas.

Another variable on which fairly consistent results have been obtained is the organization of the teacher's presentation. Here, a considerable number of experiments have been carried out. In these experiments, the organization of the teacher's lecture has been varied from what the teacher started out with, which he considered to be good organization, to much lower and lower degrees of organization by randomly mixing up the sections or paragraphs of the lecture.

Finally, let me turn to another variable that seems to be yielding fairly consistent results. This is the degree to which the teacher asks higher-order questions, that is, questions that call upon the student to do some thinking, or information processing, rather than merely recall and regurgitate what he has already been told or has read. Questions that call for mere recall of what has been read or heard are called lower-order questions. Here, both correlational studies and some recent experiments have yielded fairly consistent results concerning the effects of more or fewer higher-order questions on student achievement in classroom recitation teaching.

Obviousness

Now, you may be wondering whether the four examples I have presented have yielded anything that any intelligent citizen would not already have known. Certainly, enthusiasm helps. Certainly, acceptance of student ideas ought to help, because it helps get the students involved in the classroom discourse when their own ideas are paid some respectful attention. Certainly, better organized lectures are easier to comprehend. And certainly, asking thought-provoking questions has better educational effects than asking mere fact or knowledge questions.

Perhaps

But one interesting fact about research on teaching is that it does not always yield the results that common sense would lead you to expect. The first two variables that I have mentioned, namely, enthusiasm and acceptance of student ideas, have indeed yielded the positive relationships with student achievement that, in retrospect, seem so obvious and platitudinous. But the other two variables have not yielded what common sense would lead us to anticipate. It has consistently been found that scrambling the sections or paragraphs of well organized lectures does not result in any deterioration of what the students learn from the lectures. And it has also consistently been found that lower proportions of higher-order questions produce better student knowledge and also comprehension than do higher proportions of higher-order questions. The

last two relationships run counter to much of the dogma and so-called theory that educators have tended to accept. The fact that empirical evidence does not support these propositions should serve as a warning that there is no good substitute for empirical research when it comes to establishing valid knowledge about that extremely important form of human activity called teaching.

Summary

Let me try to summarize very quickly what I have had to offer. I have given you reasons for conducting research on teaching. I have run quickly through the various kinds of variables that are studied in research on teaching. Then I went into the types of possible relationships that can be studied between these categories of variables. These types of relationships constitute models for research on teaching, and when they are combined with the alternative major methods of determining relationships, they spell out in some detail the various kinds of research on teaching that are logically possible. Then I went into the various substantive models for research on teaching and sketched the alternatives of inter-strategy and intra-strategy comparisons. I illustrated some of the most recent thinking about research on teaching by giving you examples from the reports of the Panels of the NIE Conference on Studies in Teaching. Finally, I gave some examples of findings from research on teaching--two of which conform closely to what any intelligent person might expect, and two of which run counter to that very same kind of expectation.

In conclusion, I can only say that there is, to put it mildly, room for more and better effort. So far, what has been done does not come close to being commensurate with the importance and fascination of teaching. Only the surface has been touched, and we are only getting started. If you have any inclination at all to do research on teaching, please be assured that your efforts are needed. The field can use the best and most intensive effort of the minds that are concerned with education.

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